FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: **218424US2PCT**

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR): **10/030176**

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/JP00/03818	**12 June 2000**	**None**

TITLE OF INVENTION
PORTABLE RADIO

APPLICANT(S) FOR DO/EO/US
SHOJI Hideaki et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include itens (5), (6), (9) and (24) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☐ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Drawings (7 sheets)/Form PTO-1595
PCT/IB/308/Form PTO-1449

Rec'd PCT/PTO 31 JAN 2002

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/030176	PCT/JP00/03818	218424US2PCT

24. The following fees are submitted:.		CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :			
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	**$1040.00**		
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	**$890.00**		
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	**$740.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	**$710.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	**$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =		**$890.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).		**$0.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	17 - 20 =	0	x $18.00	**$0.00**	
Independent claims	3 - 3 =	0	x $84.00	**$0.00**	
Multiple Dependent Claims **(check if applicable)**.			☐	**$0.00**	

TOTAL OF ABOVE CALCULATIONS =	**$890.00**	
☐ Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.	**$0.00**	
SUBTOTAL =	**$890.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +	**$0.00**	
TOTAL NATIONAL FEE =	**$890.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☒	**$40.00**	
TOTAL FEES ENCLOSED =	**$930.00**	
	Amount to be: refunded	$
	charged	$

a. ☒ A check in the amount of **$930.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **15-0030** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Surinder Sachar
Registration No. 34,423

22850

Surinder Sachar
SIGNATURE

Marvin J. Spivak
NAME

24,913
REGISTRATION NUMBER

Jan 31 2002
DATE

SPECIFICATION

Portable Radio

Field of the Invention

The present invention relates to a portable radio, and, more particularly, concerns a portable radio provided with an antenna installed in a housing section (hereinafter, referred to as cover) that is freely opened and closed.

Background Art

Japanese Patent Laying-Open No. 8-186518 discloses one example of a radio communication device that is provided with an antenna (hereinafter, referred to as cover antenna) in a cover that is freely openable.

This cover antenna is provided with first and second components, and when the cover is opened the first component is made synchronous to the operation frequency of a transmitter-receiver circuit and when the cover is closed, the second component is made synchronous to the operation frequency of the transmitter-receiver circuit. Therefore, in either of the cases in which the cover is opened and closed, the cover antenna is made synchronous to the operation frequency of the transmitter-receiver circuit.

However, in the radio communication device in the above-mentioned document, the cover needs to be provided with virtually two antennas; consequently, the antenna efficiency might deteriorate due to coupling of these antennas. Moreover, the above-mentioned cover antenna requires two power supply lines, resulting in a complex mechanism and a difficulty in the layout of the power supply lines.

Disclosure of the Invention

The present invention has been devised to solve the above-mentioned problems. The object of the present invention is to make the layout of the power supply lines easier while preventing the degradation in the antenna efficiency in a portable radio provided with an antenna in a cover that is

freely opened and closed.

In one aspect of the present invention, the portable radio is provided with a casing, a cover, a dipole antenna, a power supply means, an open-close detection means, and a power supply control means. The cover is attached to the casing so as to be freely opened and closed. The dipole antenna is attached to the cover. The power supply means supplies power to the dipole antenna. The open-close detection means detects the opening/closing of the cover. The power supply control means controls the power supply means based upon the results of detection of the open-close detection means.

In the case when an antenna is attached to the cover, it functions as a dipole antenna when the cover is open; therefore, it is possible to obtain approximately 20% of the band having a return loss of approximately –6 dB. However, when the cover is closed, base conductors of the substrate inside the casing are placed close to each other, with the result that the band is reduced to approximately 2 % (see Fig. 2A). In order to solve this problem, the inventors of the present invention have studied hard to discover that it becomes possible to ensure a comparatively wide band having a return loss of not more than a predetermined value, by properly controlling the power supply means in response to the opening/closing of the cover when the cover is provided with one dipole antenna. More specifically, for example, parallel two-line type power supply lines are adopted as the power supply means, as will be described later, and the exciting method of these power supply lines are properly revised so that, as illustrated in Fig. 2B, it becomes possible to maintain approximately 15% of the band having a return loss of approximately –6 dB even when the cover is closed. With this arrangement, a single antenna can deal with either of the cases in which the cover is opened and closed, and different from the conventional system, it is possible to eliminate the necessity of installing two antennas. Consequently, it becomes possible to prevent the reduction of the antenna efficiency. Moreover, since it is not necessary to install two antennas, the layout of the power supply line is easily carried out.

The above-mentioned power supply means includes the parallel two-

line type power supply lines. In this case, in the state where the cover is open, the parallel two-line type power supply lines are excited in reversed phases, and in the state where the cover is closed, the parallel two-line type power supply lines are excited in the same phase. Thus, as described above, in either of the cases in which the cover is opened and closed, it becomes possible to maintain the band having a return loss of approximately –6 dB.

Moreover, the above-mentioned power-supply means may include a coaxial line. The coaxial line is provided with an external conductor and an inner conductor, with the external conductor and the casing being short-circuited; thus, in the state where the cover is open, the inner conductor is excited, and in the state where the cover is closed, the external conductor is excited.

In this manner, the external conductor is excited with the cover being closed so that it becomes possible to obtain the same effect as the two-line type power supply line that are excited in the same phase. Moreover, the inner conductor is excited with the cover being opened so that it becomes possible to obtain the same effect as the two-line type power supply line that are excited in reversed phases. Therefore, it is assumed that in either of the cases in which the cover is opened and closed, it is possible to maintain the band having a return loss of approximately –6 dB.

Here, the gap between the power supply point of the external conductor and the short-circuit point of the casing in the external conductor is preferably set to a quarter wavelength.

Thus, since the impedance from the power supply through the short-circuit point becomes infinite, it is possible to minimize the influence of the short-circuit point given to the impedance of the power supply point.

In another aspect of the present invention, the portable radio is provided with a casing, a cover, a dipole antenna, a power supply means and a resonator. The cover is attached to the casing so as to be freely opened and closed. The dipole antenna is installed in the cover. The power supply means supplies power to the dipole antenna. The resonator, which is placed in the casing, is placed in a position close to the dipole

antenna when the cover is closed.

When the cover is closed, the band is normally narrowed. However, by placing a resonator at the above-mentioned position, the frequencies having a low return loss are dispersed. With this arrangement, for example, it is possible to obtain a frequency characteristic as shown in Fig. 7B; consequently, it becomes possible to maintain a comparatively wide band having a return loss of approximately –6 dB, even when the cover is closed. On the other hand, as shown in Fig. 7A, even when the cover is open, it becomes possible to maintain a wide band having a return loss of approximately –6 dB. As a result, it is possible to maintain a band having a return loss of approximately –6 dB in either of the cases in which the cover is opened and closed.

Here, with respect to the resonator, a quarter wavelength resonator with one end being short-circuited and the other end being opened or a half wavelength resonator with both of the ends being opened may be used.

In still another aspect of the present invention, the portable radio is provided with a casing, a cover, a dipole antenna, a power supply means, an open-close detection means, first and second matching circuits and first and second switches. The cover is attached to the casing so as to be freely opened and closed. The dipole antenna is attached to the cover. The power supply means supplies power to the dipole antenna. The open-close detection means detects the opening/closing of the cover. Based upon the result of the detection by the open-close detection means, the first switch makes a switchover between the first and second matching circuits and the power supply means. Based upon the result of the detection by the open-close detection means, the second switch makes a switchover between the first and second matching circuits and the dipole antenna.

As described above, in the case when the matching circuit is switched in response to the opening/closing of the cover, the frequencies having a low return loss are dispersed in the same manner as the case in which the resonator is installed. Thus, it is possible to maintain a band having a return loss of approximately –6 dB in either of the cases in which the cover is opened and closed.

In any one of the above-mentioned aspects, the dipole antenna is preferably extended in a direction orthogonal to the length direction of the box-shape body.

With this arrangement, when communication is made with the casing being tilted, polarized wave components perpendicular to the ground become greater, making it possible to provide a better matching property to the base station having perpendicularly polarized waves. This also makes it possible to effectively prevent the degradation in the antenna efficiency.

Moreover, in any one of the above-mentioned aspects, the top portion of the dipole antenna may be simply bent, or the top portion of the dipole antenna may be bent in a meandering shape. This makes it possible to shorten the physical length of the antenna.

Brief Description of the Drawings

Fig. 1A is a schematic diagram of a portable radio in accordance with a first embodiment of the present invention.

Fig. 1B is a block diagram that explains a power supply method of the present invention.

Fig. 2A is a drawing that shows the relationship between the return loss and the frequency in the case when an antenna without any modification is excited in a reversed phase with the cover being closed in the portable radio shown in Fig. 1A.

Fig. 2B is a drawing that shows the relationship between the return loss and the frequency in the case when an antenna is excited in the same phase with the cover being closed in the portable radio shown in Fig. 1A.

Fig. 3A is a schematic diagram showing a radio in a second embodiment of the present invention.

Fig. 3B is a schematic diagram showing a modified example of the portable radio shown in Fig. 3A.

Fig. 4A is a schematic diagram showing a portable radio in a third embodiment of the present invention.

Fig. 4B is a partially enlarged side view of the portable radio shown in Fig. 4A.

Fig. 5A is a schematic diagram showing a portable radio in a fourth embodiment of the present invention.

Fig. 5B is a drawing that shows a state in which the cover of the portable radio of Fig. 5A is closed.

Fig. 6A is a schematic diagram showing a portable radio in a fifth embodiment of the present invention.

Fig. 6B is a circuit diagram that shows one example of a first matching circuit in Fig. 6A.

Fig. 6C is a circuit diagram that shows one example of a second matching circuit in Fig. 6A.

Fig. 7A is a drawing that shows the relationship between the return loss and the frequency in the case when an antenna is excited with the cover being opened in the portable radios of types shown in Figs. 5A and 6A.

Fig. 7B is a drawing that shows the relationship between the return loss and the frequency in the case when an antenna is excited with the cover being closed in the portable radios of types shown in Figs. 5A and 6A.

Best Mode for Carrying Out the Invention

Referring to Figs. 1A to 7B, the following description will discuss embodiments of the present invention.

(First Embodiment)

As illustrated in Fig. 1A, a portable radio 1 is provided with a casing 2 (base conductor), a cover (flip) 3 that is freely opened and closed, a dipole antenna 5, first and second power supply lines 4a, 4b, first and second power supplies 6a, 6b that are RF (Radio Frequency) power supplies and a cover open-close detection means 7.

Cover 3, which is attached to casing 2 so as to be freely opened and closed, is made from a dielectric material such as an organic polymer, and has dipole antenna 5 placed therein. The length L1 of dipole antenna 5 is a half-wavelength ($\lambda/2$), and this is extended in a direction orthogonal to the length direction of casing 2. Thus, when communication is made with casing 2 being tilted, polarized wave components perpendicular to the ground increase, thereby making it possible to provide a better matching

property to a base station having perpendicularly polarized waves.

First and second power supply lines 4a, 4b and first and second power supplies 6a, 6b are allowed to function as power supply means for dipole antenna 5. As illustrated in Fig. 1, first and second power supply lines 4a, 4b are parallel two-line type power supply lines, and first and second power supply lines 4a, 4b are connected to casing 2 through power supplies 6a, 6b respectively. An electrical length L2, which is obtained by adding first or second power supply lines 4a, 4b and a half of dipole antenna 5, is set to $\lambda/4 + N \times \lambda/2$ (N: an integer of not less than 1).

With respect to cover open-close detection means 7 for detecting the opening and closing of cover 3, for example, a cover open-close detection means that has been disclosed in Japanese Patent Laying-Open No. 6-291820 may be used. Based upon the result of detection by cover open-close detection means 7, power supplies to first and second power supply lines 4a, 4b are controlled.

More specifically, upon detection of the opening of cover 3 by cover open-close detection means 7, first and second power supply lines 4a, 4b are excited in phases reversed to each other, and upon detection of the closing of cover 3 by cover open-close detection means 7, first and second power supply lines 4a, 4b are excited in the same phase.

In a mode shown in Fig. 1A, the operations of first and second power supplies 6a, 6b (power supply means) are controlled by a control means, not shown, in response to the opening and closing of cover 3 so that the excited states of first and second power supply lines 4a, 4b are controlled as described above in response to the opening and closing of cover 3.

In a state where the cover is open, since the operation of a normal dipole antenna is available, it is possible to obtain approximately 20 % of a band having a return loss of not more than –6 dB. Moreover, Fig. 2B shows a frequency characteristic when cover 3 is closed. It is confirmed from Fig. 2B that approximately 15 % of a band having a return loss of not more than –6 dB is obtained. Thus, the above-mentioned power-supply control makes it possible to maintain a band having a return loss of approximately –6 dB in either of the cases in which the cover is opened and

closed.

In other words, even in the case when a single dipole antenna 5 is placed in cover 3, by properly controlling the power supply means in response to the opening and closing of cover 3, it is possible to maintain a band having a return loss of not more than a predetermined value.

With this arrangement, the single antenna can properly deal with either of the cases where cover 3 is opened and closed so that, different from the conventional example, it is possible to eliminate the necessity of installing two covers in the cover. Consequently, it becomes possible to prevent degradation in the antenna efficiency. Moreover, since it is not necessary to install two antennas, the layout of the power supply line is easily carried out.

Here, as illustrated in Fig. 1B, a single power supply 6 is installed and a power supply control means 8 is placed between this power supply 6 and first and second power supply lines 4a, 4b so that power supply control means 8 may be connected to cover open-close detection means 7. In this case also, first and second power supply lines 4a, 4b are excited respectively as described above, in response to the opening and closing of cover 3. With respect to power supply control means 8, for example, a distributor may be used.

(Second Embodiment)

Next, referring to Figs. 3A and 3B, explanations will be given of the second embodiment and its modified examples.

As illustrated in Fig. 3A, in the second embodiment, the top portion of dipole antenna 5 is bent. Thus, the physical length of dipole antenna 5 is shortened. Thus, it becomes possible to make dipole antenna 5 compacter. The structures other than this are the same as those of the first embodiment shown in Fig. 1A.

Moreover, as illustrated in Fig. 3B, the top portion of the dipole antenna 5 may be bent in a meandering shape. This arrangement also makes it possible to provide the same effects.

(Third Embodiment)

Next, referring to Figs. 4A and 4B, an explanation will be given of

the third embodiment of the present invention. As illustrated in Fig. 4A, in the third embodiment, a coaxial line 9 is used as the power supply line. Coaxial line 9 is provided with an external conductor 9a and an inner conductor 9b, and external conductor 9a and casing 2 are short-circuited. In other words, external conductor 9a is grounded.

As illustrated in Fig. 4B, coaxial line 9 is placed apart from casing 2, with one end of external conductor 9a being short-circuited by casing 2 at a short-circuit point 11. Moreover, as illustrated in Figs. 4A and 4B, a distance L3 between a power supply point 10 of external conductor 9a and short-circuit point 11 is set to approximately $\lambda/4$. Thus, since the impedance from power supply 6a through short-circuit point 11 becomes infinite, it is possible to minimize the influence of short-circuit point 11 given to the impedance of power supply point 10.

In the third embodiment, inner conductor 9b is excited with cover 3 being opened, and external conductor 9a is excited with cover 3 being closed.

In this manner, by exciting external conductor 9a with cover 3 being closed, it is possible to obtain the same effects as those obtained when the parallel two-line type power supply line are excited in the same phase. Moreover, by exciting inner conductor 9b with cover 3 being opened, it is possible to obtain the same effects as those obtained when the parallel two-line type power supply line are excited in reversed phases.

Therefore, in the third embodiment also, in the same manner as the first embodiment, it becomes possible to maintain a band having a return loss of approximately –6 dB in either of the cases in which cover 3 is opened and closed.

(Fourth Embodiment)

Next, referring to Figs. 5A and 5B, an explanation will be given of the fourth embodiment of the present invention.

The invention of the fourth embodiment and the invention of the fifth embodiment, which will be described later, have been devised so as to utilize two bands that are separated from each other.

In the state where cover 3 is opened, since the irradiation portion is made apart from the body of the user, it is possible to prevent the reduction

in efficiency due to the human body. However, in the state where cover 3 is closed, the band is normally narrowed, resulting in a problem in which it is difficult to cover the two separated bands. Therefore, a resonance circuit is used so as to disperse frequencies having a low return loss.

As illustrated in Fig. 5A, a resonator 9 is placed in casing 2 in the fourth embodiment as one method for achieving the above-mentioned purpose. Resonator 9 is placed at a position close to dipole antenna 5 at the time when cover 3 is closed as illustrated in Fig. 5B, and excited by dipole antenna 5 in a non-contact state. Here, with respect to dipole antenna 5 and its power supply means, the same members as those used in the above-mentioned embodiments may be used.

By installing resonator 9 at the above-mentioned position, it is possible to disperse frequencies having a low return loss, and consequently to obtain a frequency characteristic, for example, shown in Fig. 7B. In other words, it becomes possible to ensure two portions of bands having a return loss of approximately –6 dB, even when cover 3 is closed.

On the other hand, at the time when cover 3 is opened, since the operation of a normal dipole antenna is available, it is possible to maintain a wide band having a return loss of approximately –6 dB as shown in Fig. 7A. As a result, in either of the cases in which the cover is opened and closed, it becomes possible to maintain a band having a return loss of approximately –6 dB.

Here, with respect to resonator 9, a $\lambda/4$ resonator with one end being short-circuited and the other end being opened [a resonator having a length L4 of $\lambda/4 + N \times \lambda/2$ (N: an integer of not less than 1)] may be used, or a $\lambda/2$ resonator with both of the ends being opened [a resonator having a length of $N \times \lambda/2$ (N: an integer of not less than 1)] may be used. Moreover, with respect to resonator 9, for example, those having a plate shape, a line shape, a meandering shape and a helical shape may be used.

(Fifth Embodiment)

Next, referring to Figs. 6A to 6C, an explanation will be given of the fifth embodiment of the present invention. In the fifth embodiment, matching circuits are switched by using a switch so that at the time when

cover 3 is closed, frequencies having a low return loss can be dispersed.

As illustrated in Fig. 6A, portable radio 1 in accordance with the fifth embodiment is provided with first and second matching circuits 12, 13, first and second switches 14, 15 and power supply 6.

First matching circuit 12 is connected to dipole antenna 5 when cover 3 is opened. Second matching circuit 13 is connected to dipole antenna 5 when cover 3 is closed.

Figs. 6B and 6C show structural examples of first and second matching circuits 12, 13. As illustrated in Figs. 6B and 6C, each of first and second matching circuits 12, 13 is provided with a capacitor 16 and a coil 17.

Based upon the result of detection by open-close detection means 7, first switch 14 switches and connects first and second matching circuits 12, 13 and power supply 6 as described above. Based upon the result of detection by open-close detection means 7, second switch 15 switches and connects first and second matching circuits 12, 13 and dipole antenna 5. In other words, when cover 3 is opened, first matching circuit 12 is connected to power supply 6 and dipole antenna 5, and when cover 3 is closed, second matching circuit 13 is connected to power supply 6 and dipole antenna 5. Here, it is possible to use a power supply line other than coaxial line 9.

In the present embodiment also, in the same manner as the fourth embodiment, characteristics shown in Figs. 7A and 7B are obtained. Therefore, in either of the cases in which cover 3 is opened and closed, it becomes possible to maintain a band having a return loss of approximately –6 dB.

While the invention has been shown and described in detail, the foregoing description is in all aspects illustrative and not restrictive. It is therefore understood that numerous other modifications and variations can be devised without departing from the scope of the invention.

Industrial Applicability

The present invention can be effectively applied to a portable radio

in which an antenna is installed in a cover (flip) that is attached to a casing so as to be freely opened and closed.

CLAIMS

1. A portable radio comprising:

a casing (2);

a cover (3) attached to said casing (2) so as to be freely opened and closed;

a dipole antenna (5) attached to said cover (3);

power supply means (4a, 4b, 6a, 6b) for supplying power to said dipole antenna (5);

open-close detection means (7) for detecting the opening/closing of said cover (3); and

power supply control means (8) for controlling said power supply means (4a, 4b, 6a, 6b) based upon results of detection of said open-close detection means (7).

2. The portable radio according to claim 1, wherein said power supply means (4a, 4b, 6a, 6b) comprises parallel two-line type power supply lines (4a, 4b), said parallel two-line type power supply lines being excited in reversed phases in a state where said cover (3) is open, said parallel two-line type power supply lines being excited in the same phase in a state where said cover (3) is closed.

3. The portable radio according to claim 1, wherein: said power supply means (4a, 4b, 6a, 6b) comprises a coaxial line (9), said coaxial line (9) being provided with an external conductor (9a) and an inner conductor (9b), with said external conductor (9a) and said casing (2) being short-circuited, and excites said inner conductor (9b) in a state where said cover (3) is open, and excites said external conductor (9a) in a state where said cover (3) is closed.

4. The portable radio according to claim 3, wherein a power supply point (10) of said external conductor (9a) and a short-circuit point (11) of said external conductor (9a) to said casing (2) has a gap of a quarter

wavelength.

5. The portable radio according to claim 1, wherein said dipole antenna (5) is extended in a direction orthogonal to a length direction of said casing (2).

6. The portable radio according to claim 1, wherein said dipole antenna (5) has a top end that is bent.

7. The portable radio according to claim 1, wherein said dipole antenna (5) has a top end that is bent into a meandering shape.

8. A portable radio comprising:

a casing (2);

a cover (3) attached to said casing (2) so as to be freely opened and closed;

a dipole antenna (5) attached to said cover (3);

power supply means (6) for supplying power to said dipole antenna (5); and

a resonator (9) installed in said casing (2),

wherein said resonator (9) is placed in a position close to said dipole antenna (5) when said cover (3) is closed.

9. The portable radio according to claim 8, wherein said resonator (9) comprises a quarter wavelength resonator with one end being short-circuited, the other end being opened.

10. The portable radio according to claim 8, wherein said resonator (9) comprises a half wavelength resonator with both of the ends being opened.

11. The portable radio according to claim 8, wherein said dipole antenna (5) is extended in a direction orthogonal to a length direction of

said casing (2).

12. The portable radio according to claim 8, wherein said dipole antenna (5) has a top end that is bent.

13. The portable radio according to claim 8, wherein said dipole antenna (5) has a top end that is bent into a meandering shape.

14. A portable radio comprising:

a casing (2);

a cover (3) attached to said casing (2) so as to be freely opened and closed;

a dipole antenna (5) attached to said cover (3);

power supply means (6) for supplying power to said dipole antenna (5);

open-close detection means (7) for detecting the opening/closing of said cover (3);

first and second matching circuits (12, 13);

a first switch (14) which, based upon the result of detection by said open-close detection means (7), makes a switchover between said first and second matching circuits (12, 13) and said power supply means (6); and

a second switch (15) which, based upon the result of detection by said open-close detection means (7), makes a switchover between said first and second matching circuits (12, 13) and said dipole antenna (5).

15. The portable radio according to claim 14, wherein said dipole antenna (5) is extended in a direction orthogonal to a length direction of said casing (2).

16. The portable radio according to claim 14, wherein said dipole antenna (5) has a top end that is bent.

17. The portable radio according to claim 14, wherein said dipole antenna (5) has a top end that is bent into a meandering shape.

FIG.1A

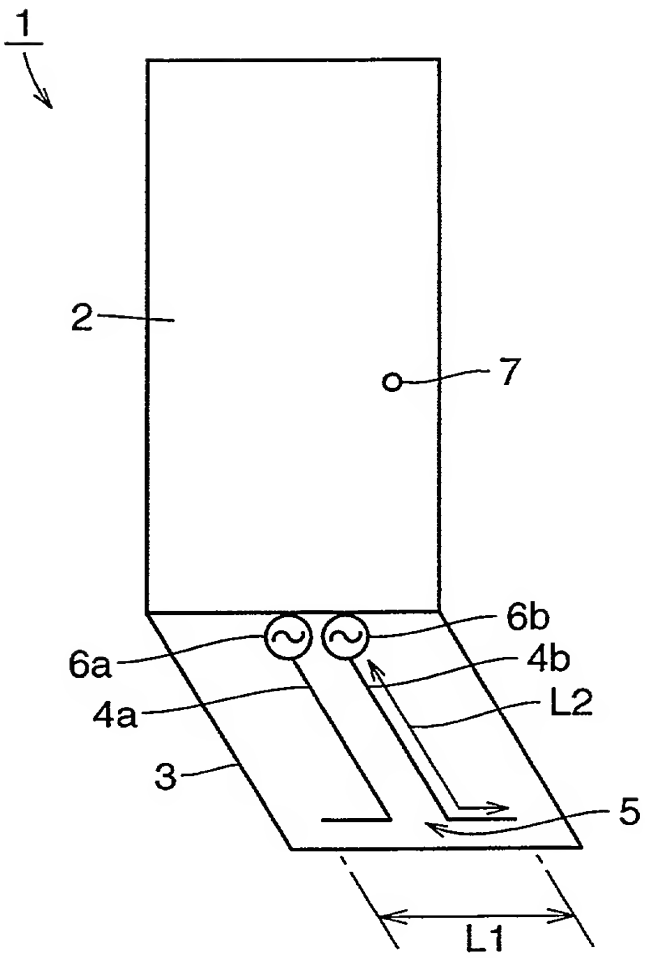

1
2
7
6b
6a
4b
4a
L2
3
5
L1

FIG.1B

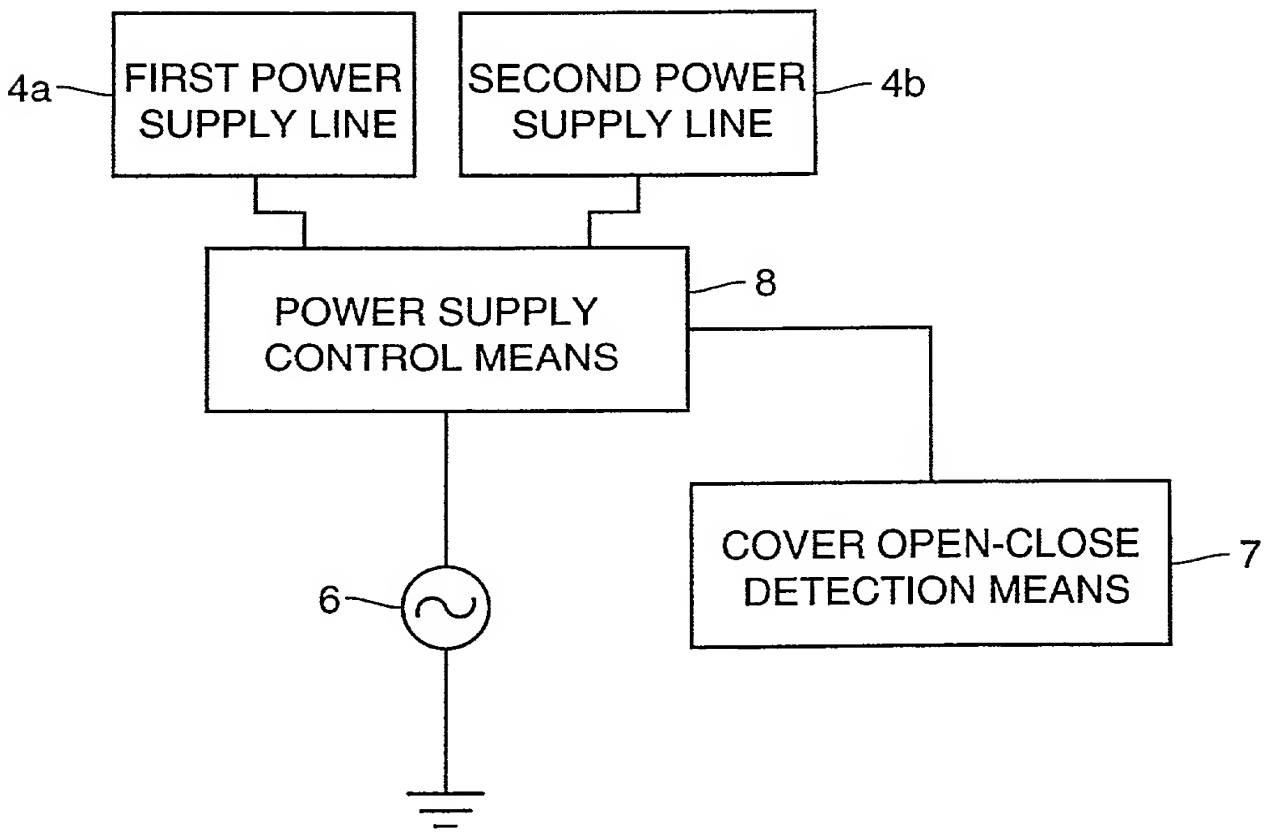

4a
FIRST POWER SUPPLY LINE
SECOND POWER SUPPLY LINE
4b
POWER SUPPLY CONTROL MEANS
8
6
COVER OPEN-CLOSE DETECTION MEANS
7

FIG.2A

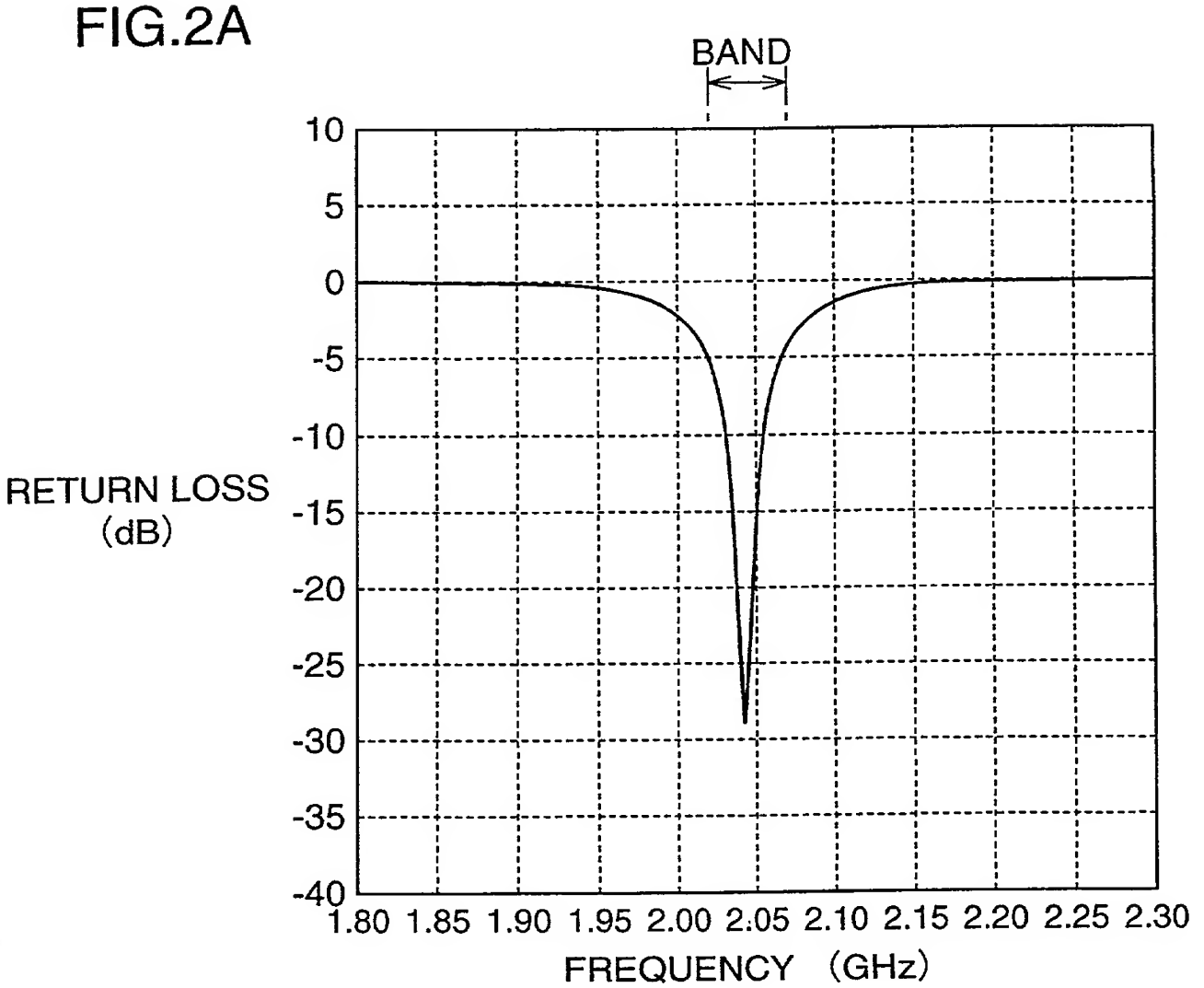
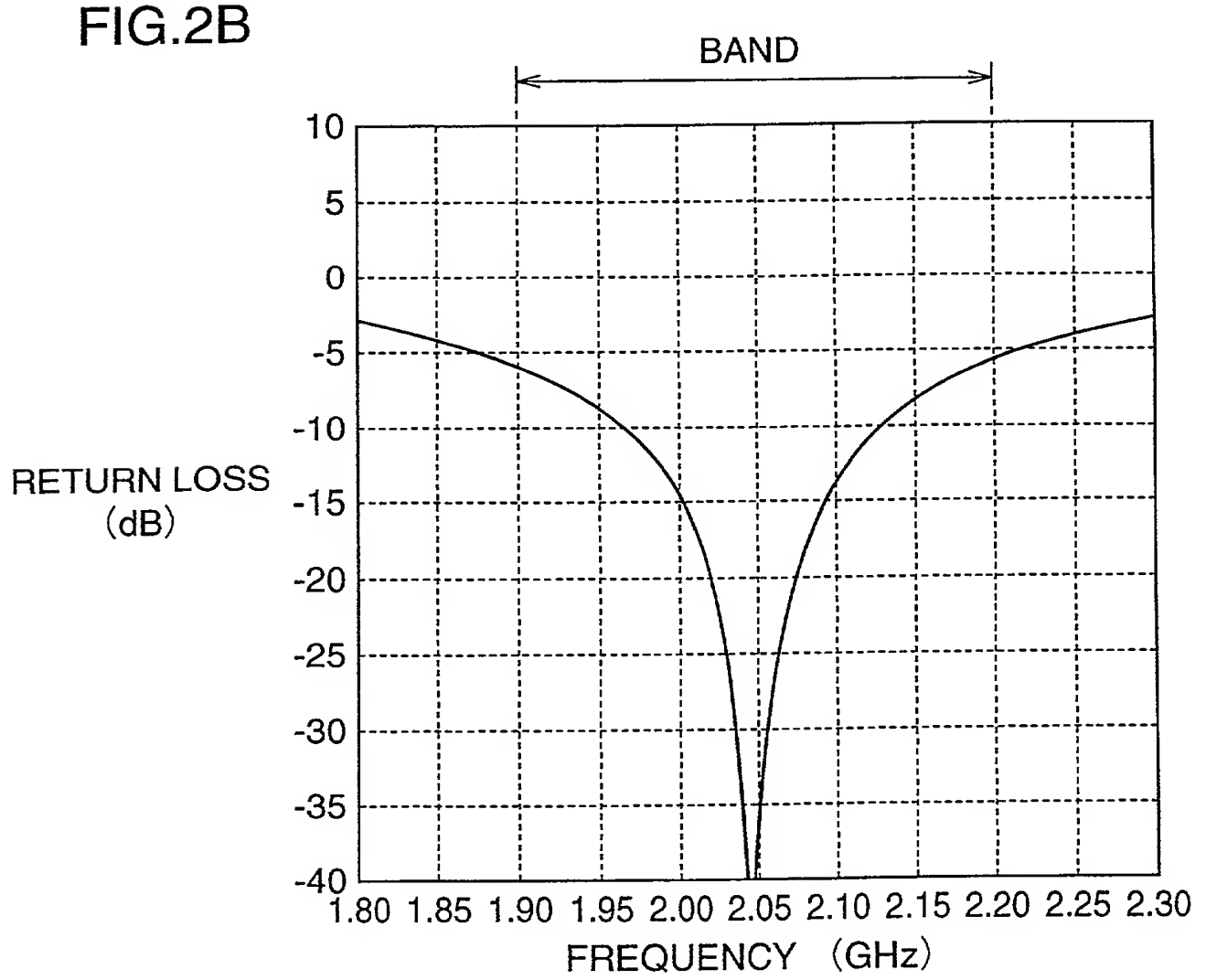

BAND
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
RETURN LOSS
(dB)
1.80 1.85 1.90 1.95 2.00 2.05 2.10 2.15 2.20 2.25 2.30
FREQUENCY (GHz)

FIG.2B


BAND
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
RETURN LOSS
(dB)
1.80 1.85 1.90 1.95 2.00 2.05 2.10 2.15 2.20 2.25 2.30
FREQUENCY (GHz)

10/030176

FIG.3A

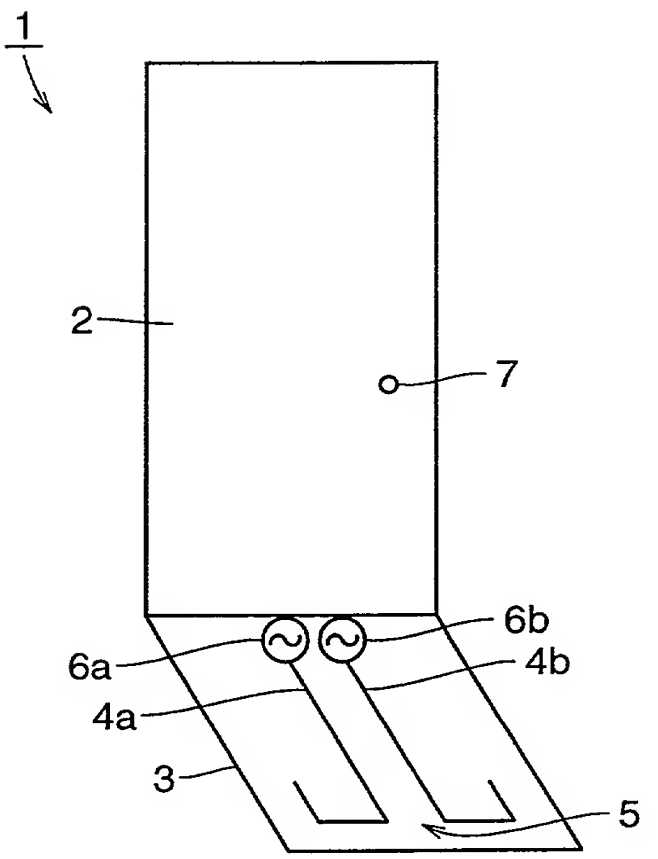


FIG.3B

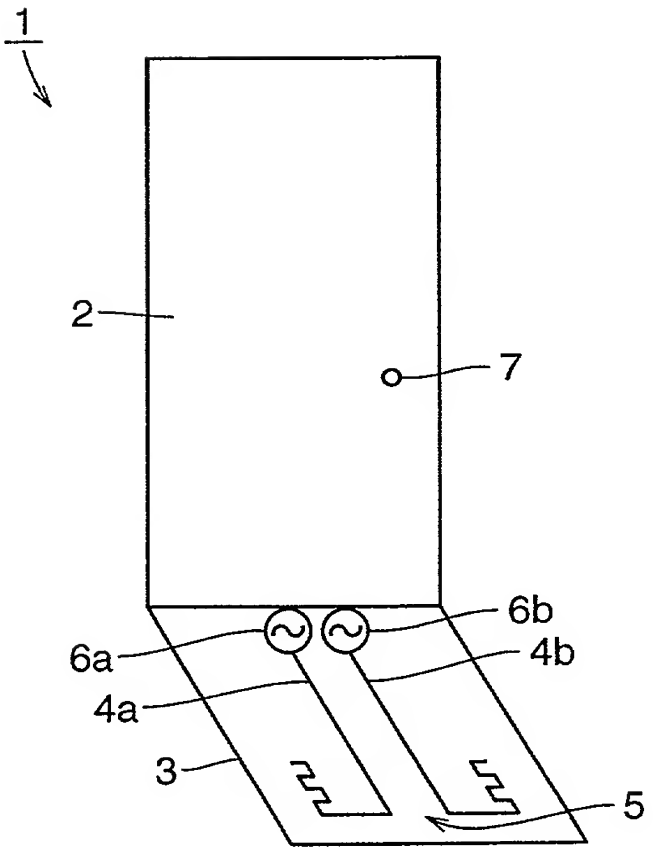


FIG.4A

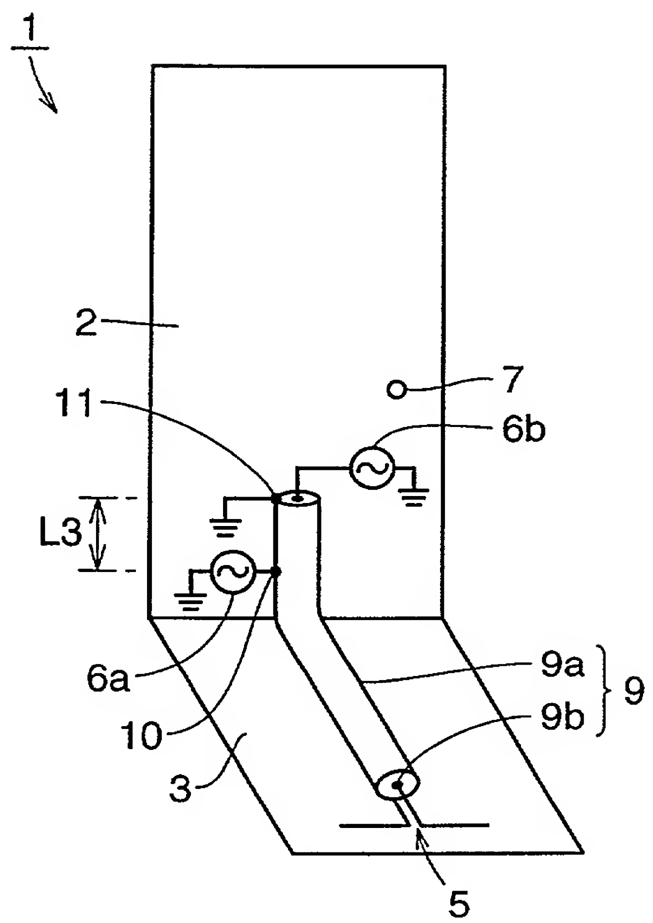


FIG.4B

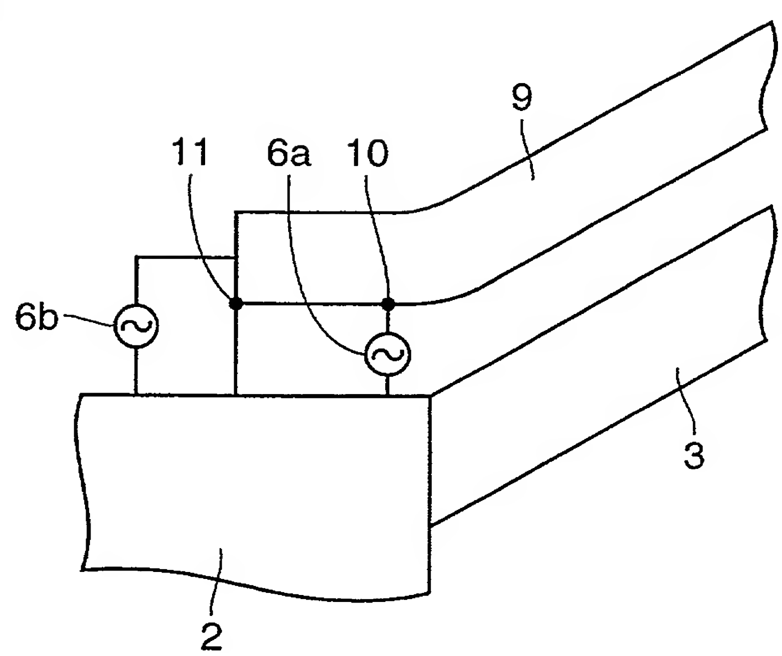


FIG.5A

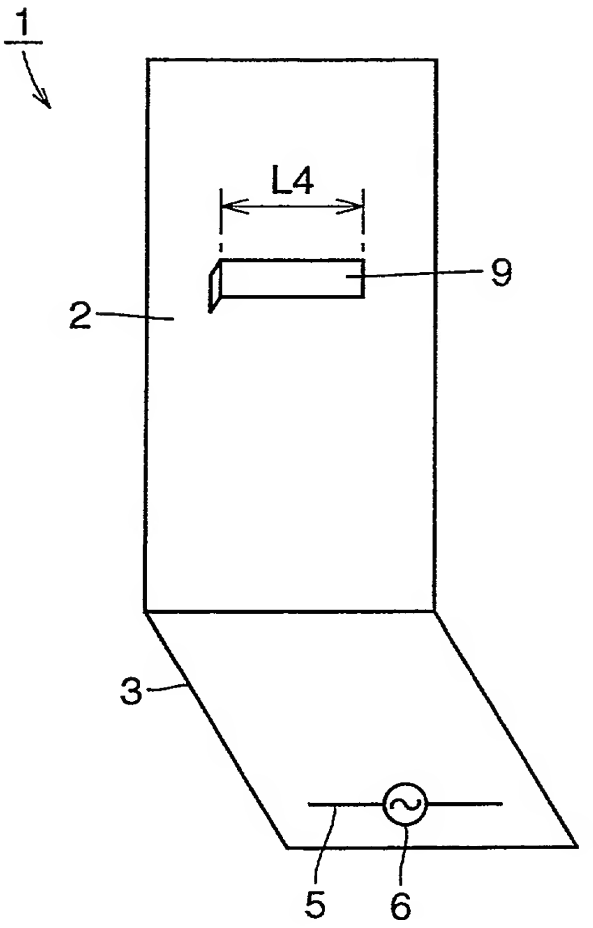
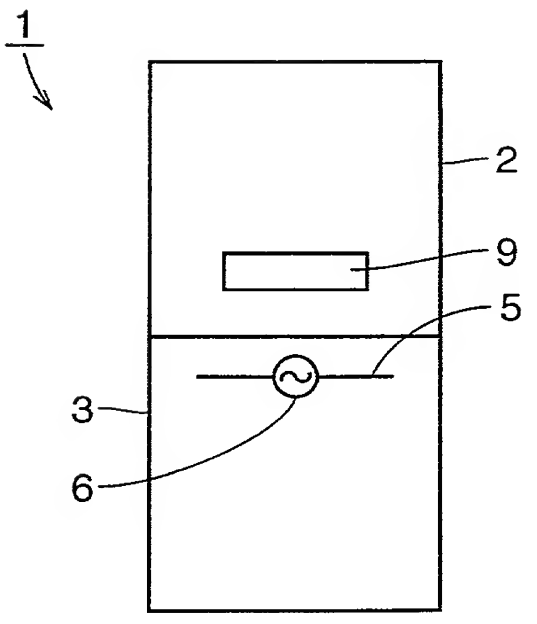


FIG.5B



10/030176

FIG.6A

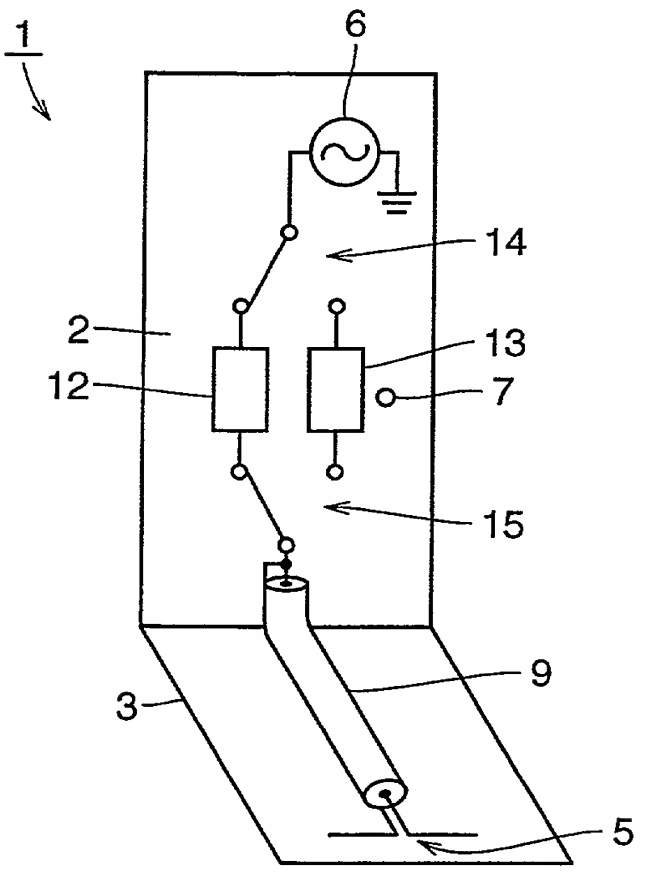


FIG.6B

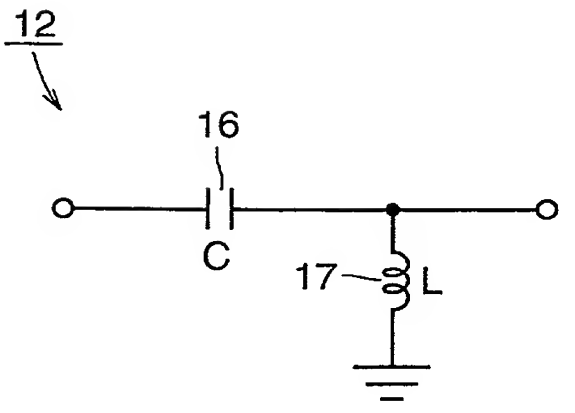


FIG.6C

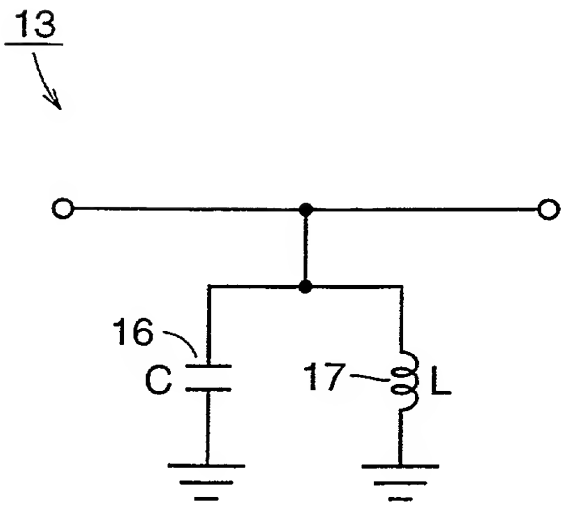


FIG.7A

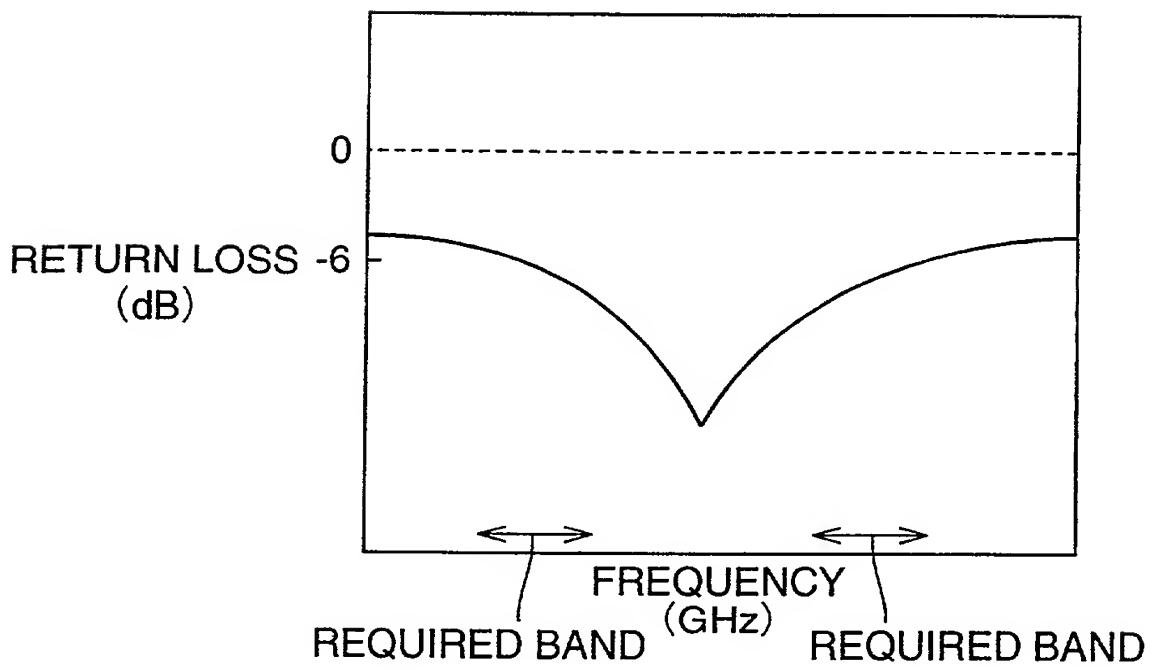
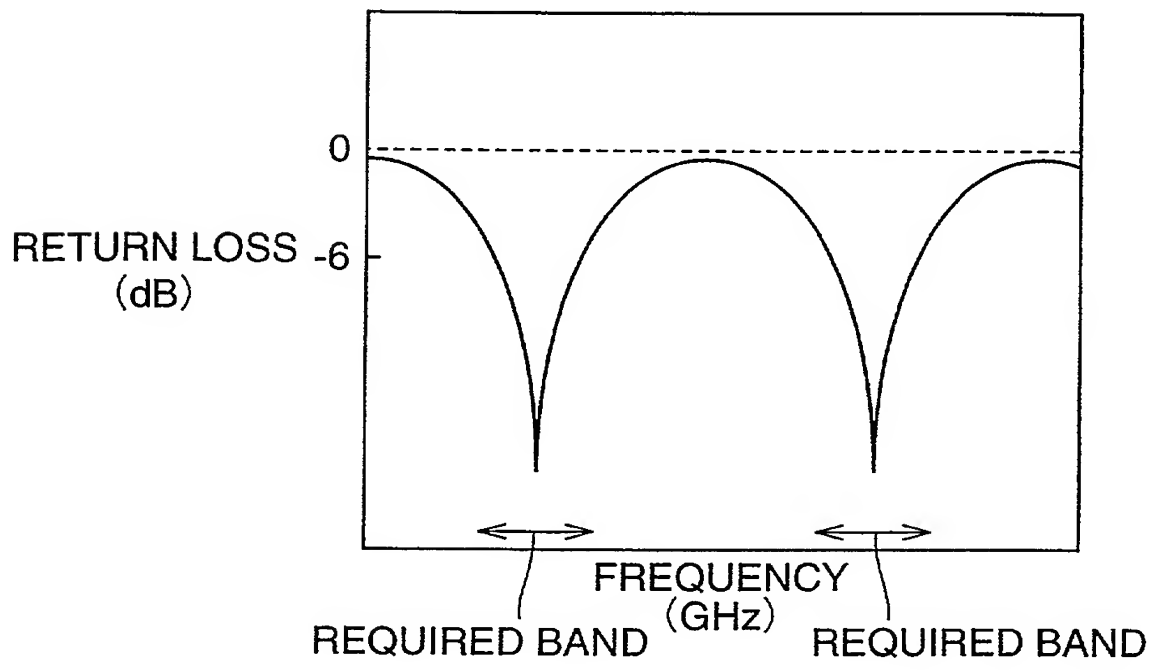


FIG.7B



Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者（下記の名称が複数の場合）であると信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled.

PORTABLE RADIO

上記発明の明細書は、

☐ 本書に添付されています。

☐ ___月___日に提出され、米国出願番号または特許協定条約国際出願番号を_____とし、
（該当する場合）_____に訂正されました。

the specification of which

☒ is attached hereto.

☒ was filed on June 12, 2000
as United States Application Number or
PCT International Application Number
PCT/JP00/03818 and was amended on
_____ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Japanese Language Declaration
(日本語宣言書)

私は、米国法典第35編119条（a）-（d）項又は365条（b）項に基づき下記の、米国以外の国の少なくとも一ヵ国を指定している特許協力条約365（a）項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)
外国での先行出願

(Number) (番号)	(Country) (国名)	(Day/Month/Year Filed) (出願年月日)	Priority Claimed 優先権主張 ☐ Yes はい	☐ No いいえ
(Number) (番号)	(Country) (国名)	(Day/Month/Year Filed) (出願年月日)	☐ Yes はい	☐ No いいえ

私は、第35編米国法典119条（e）項に基づいて下記の米国特許出願規定に記載された権利をここに主張いたします。

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.) (出願番号)	(Filing Date) (出願日)
(Application No.) (出願番号)	(Filing Date) (出願日)

私は、下記の米国法典第35編120条に基づいて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約365条（c）に基づく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第37編1条56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Application No.) (出願番号)	(Filing Date) (出願日)	(Status: Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)
(Application No.) (出願番号)	(Filing Date) (出願日)	(Status: Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)

私は、私自信の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じるところに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration
(日本語宣言書)

委任状：私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。
(弁護士、または代理人の指名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: *(list name and registration number)*

022850

書類送付先

Send Correspondence to:

022850

直接電話連絡先：（名前及び電話番号）

Direct Telephone Calls to: (name and telephone number)

(703) 413-3000

単独発明者または第一の共同発明者の氏名 100	Full name of sole or first joint inventor Hideaki SHOJI
発明者の署名　日付	Inventor's signature　Date Hideaki Shoji　November 15, 2001
住所	Residence Hyogo, Japan JPX
国籍	Citizenship Japanese
郵便の宛先	Post Office Address c/o Mitsubishi Denki Kabushiki Kaisha,
	2-3, Marunouchi 2-chome, Chiyoda-ku, TOKYO 100-8310 JAPAN
第二の共同発明者の氏名 200	Full name of second joint inventor, if any Yasuhito IMANISHI
第二の共同発明者の署名　日付	Second joint Inventor's signature　Date Yasuhito Imanishi　November 6, 2001
住所	Residence Hyogo, Japan JPX
国籍	Citizenship Japanese
郵便の宛先	Post Office Address c/o Mitsubishi Denki Kabushiki Kaisha,
	2-3, Marunouchi 2-chome, Chiyoda-ku, TOKYO 100-8310 JAPAN

(第三以降の共同発明者についても同様に記載し、署名すること)

(Supply similar information and signature for third and subsequent joint inventors.)

Japanese Language Declaration
(日本語宣言書)

第三の共同発明者の氏名 300	Full name of third joint inventor, if any Toru FUKASAWA
第三の共同発明者の署名 日付	Third joint Inventor's signature Date Toru Fukasawa 2001-11-7
住所	Residence Hyogo, Japan JPX
国籍	Citizenship Japanese
郵便の宛先	Post Office Address c/o Mitsubishi Denki Kabushiki Kaisha,
	2-3, Marunouchi 2-chome, Chiyoda-ku, TOKYO 100-8310 JAPAN

第四の共同発明者の氏名 400	Full name of fourth joint inventor, if any Hiroyuki OHMINE
第四の共同発明者の署名 日付	Fourth joint Inventor's signature Date Hiroyuki Ohmine Nov. 8, 2001
住所	Residence Hyogo, Japan JPX
国籍	Citizenship Japanese
郵便の宛先	Post Office Address c/o Mitsubishi Denki Kabushiki Kaisha,
	2-3, Marunouchi 2-chome, Chiyoda-ku, TOKYO 100-8310 JAPAN

第五の共同発明者の氏名	Full name of fifth joint inventor, if any
第五の共同発明者の署名 日付	Fifth joint Inventor's signature Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address

第六の共同発明者の氏名	Full name of sixth joint inventor, if any
第六の共同発明者の署名 日付	Sixth joint Inventor's signature Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address

（第六またはそれ以降の共同発明者に対しても同様な情報および署名を提供すること。）

(Supply similar information and signature for third and subsequent joint inventors.)